CVD Risk Factor Disparities in Youth

UNTHSC Health Disparities Conference

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Justin Zachariah MD MPH

Boston Children's Hospital Heart Center

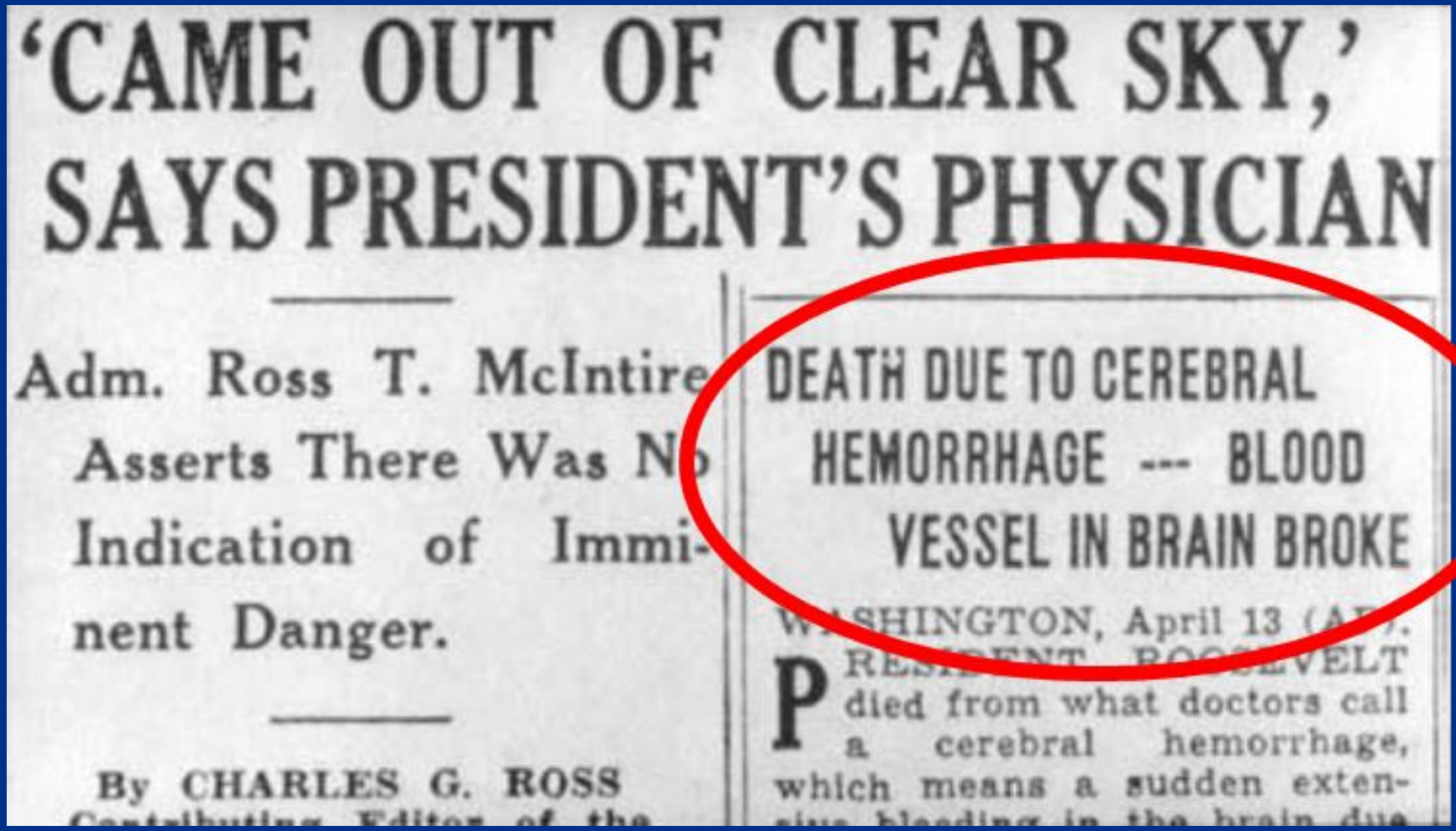
HARVARD MEDICAL SCHOOL TEACHING HOSPITAL

Disclosure

- NHLBI Career Development Award (K23)
- I have no industry disclosures
- No unapproved therapies will be discussed

Roadmap

- Pop Quiz- Historical digression
- CVD definition
- CVD developmental progression
- Risk Factors and Subclinical phenotypes
- Pediatric perspectives
- Do disparities drive our understanding?



‘CAME OUT OF CLEAR SKY,’ SAYS PRESIDENT’S PHYSICIAN

Adm. Ross T. McIntire Asserts There Was No Indication of Imminent Danger.

By CHARLES G. ROSS

DEATH DUE TO CEREBRAL HEMORRHAGE --- BLOOD VESSEL IN BRAIN BROKE

WASHINGTON, April 13 (AP). PRESIDENT ROOSEVELT died from what doctors call a cerebral hemorrhage, which means a sudden extensive bleeding in the brain due

Messerli. New England Journal of Medicine 1995

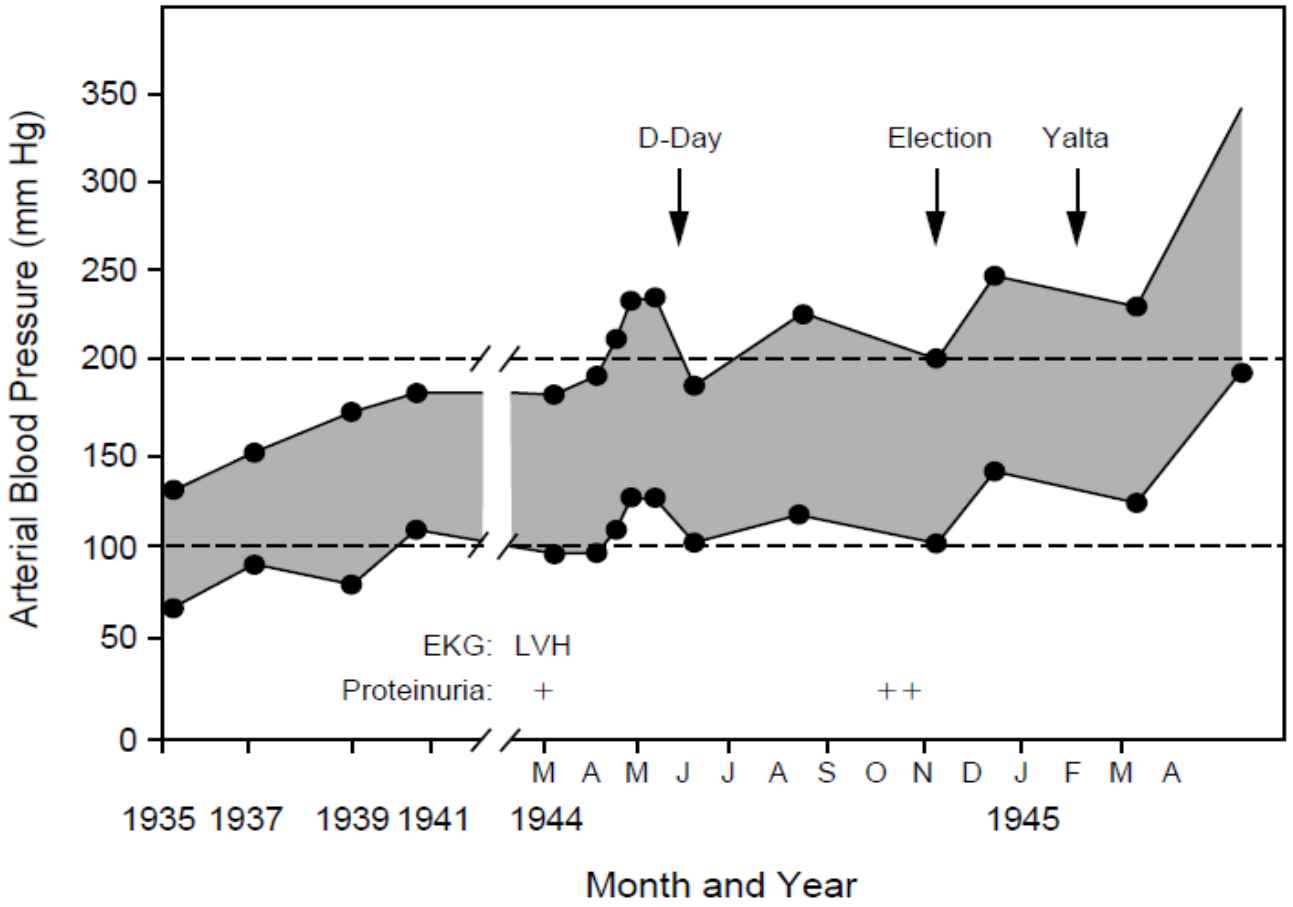


Figure 2. Diastolic and Systolic Arterial Pressure of Franklin D. Roosevelt from 1935 until His Death on April 12, 1945.

EKG denotes electrocardiogram, and LVH left ventricular hypertrophy. Data are from the diary of Dr. Howard G. Bruenn.[2]

Messerli. New England Journal of Medicine 1995

Definitions

- Cardiovascular disease events
  - Coronary: Heart attack/myocardial infarction, revascularization, coronary disease, angina
  - Cranial: Stroke (ischemic vs. hemorrhagic), transient ischemic attacks
  - Heart failure: hospitalizations or clinical symptoms
  - Other: Sudden death, arterial rupture, arrhythmia, etc.

Pathophysiologic progression

CVD risk factors

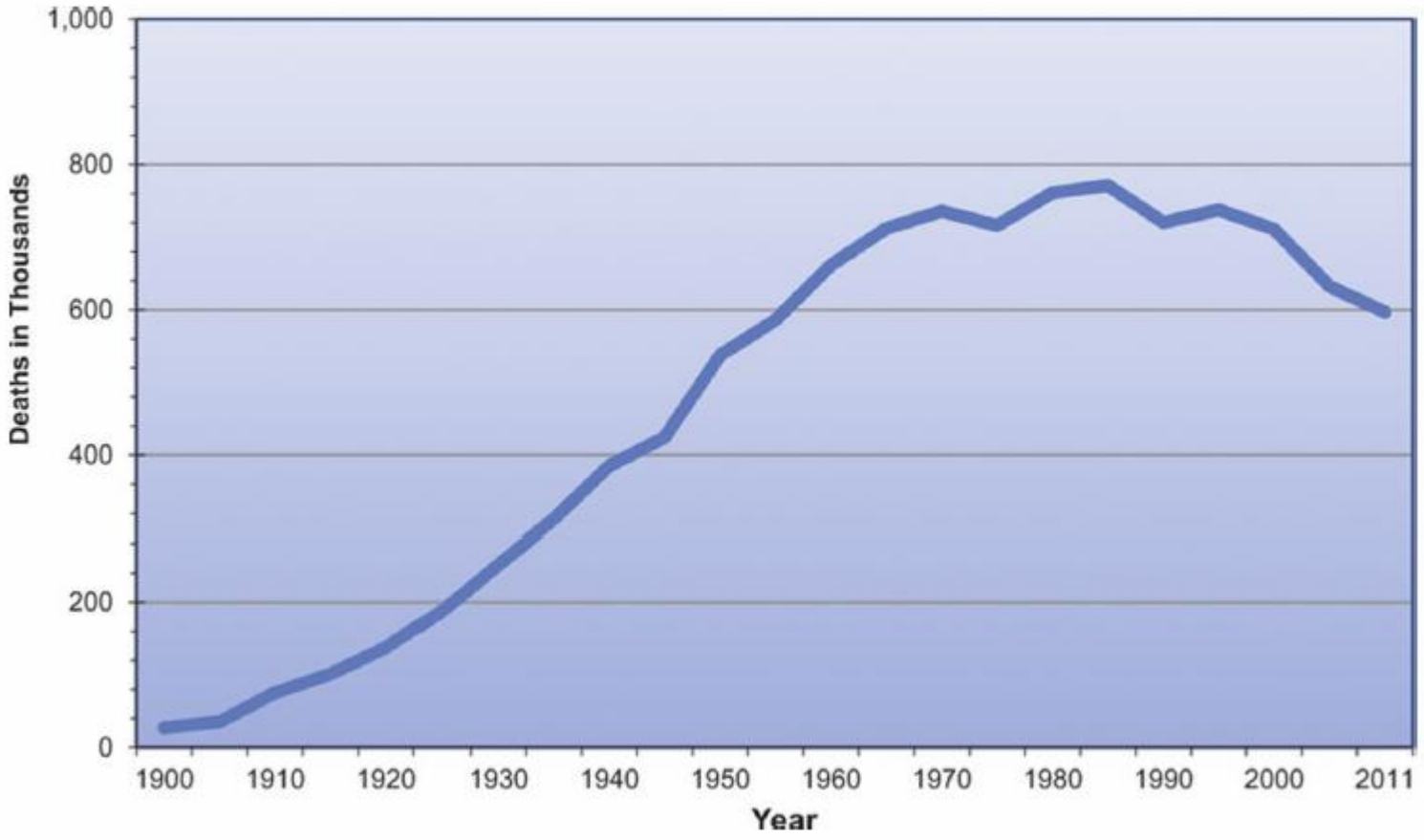
Subclinical phenotypes

CVD events

Classic CVD Risk Factors: Framingham Risk Score

- Age
- Sex
- Systolic Blood Pressure
- Total Cholesterol [=HDL+LDL+Triglycerides/5]
- HDL Cholesterol
- Smoking
- Diabetes Mellitus

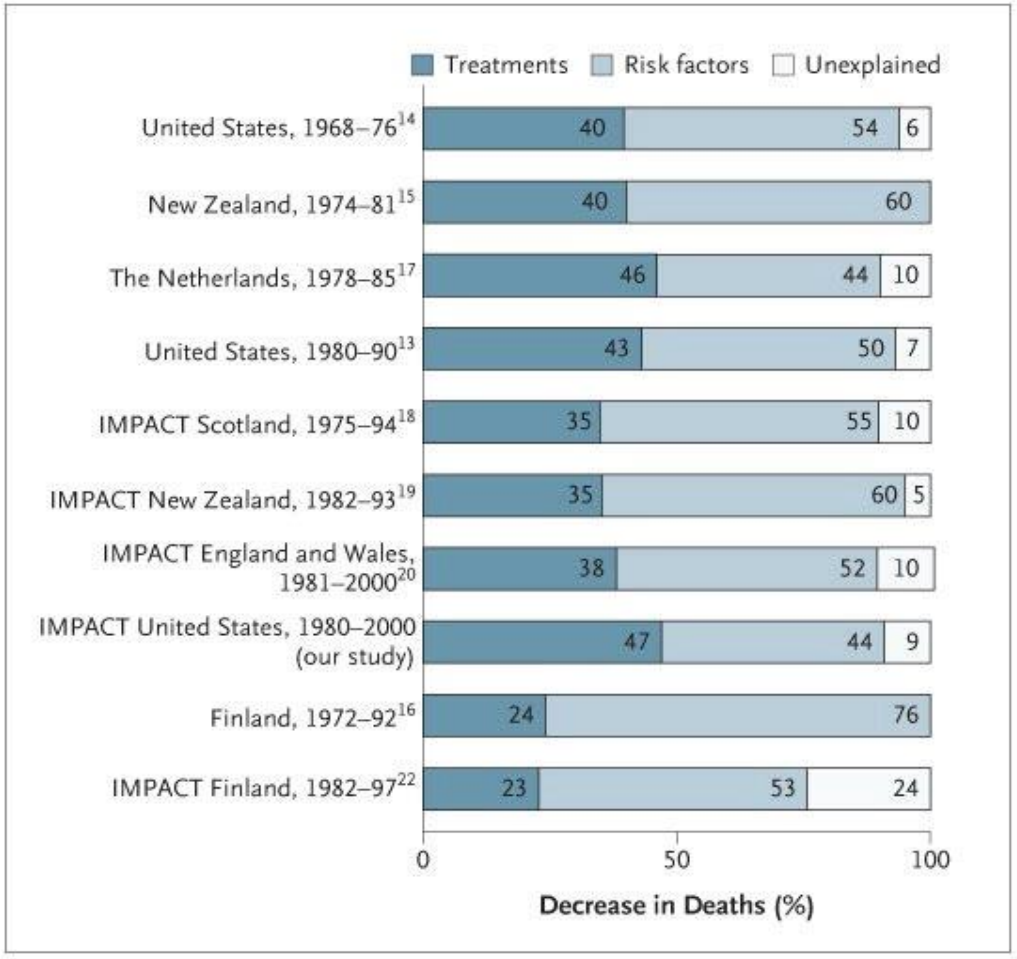
Deaths attributable to diseases of the heart (United States: 1900–2011).



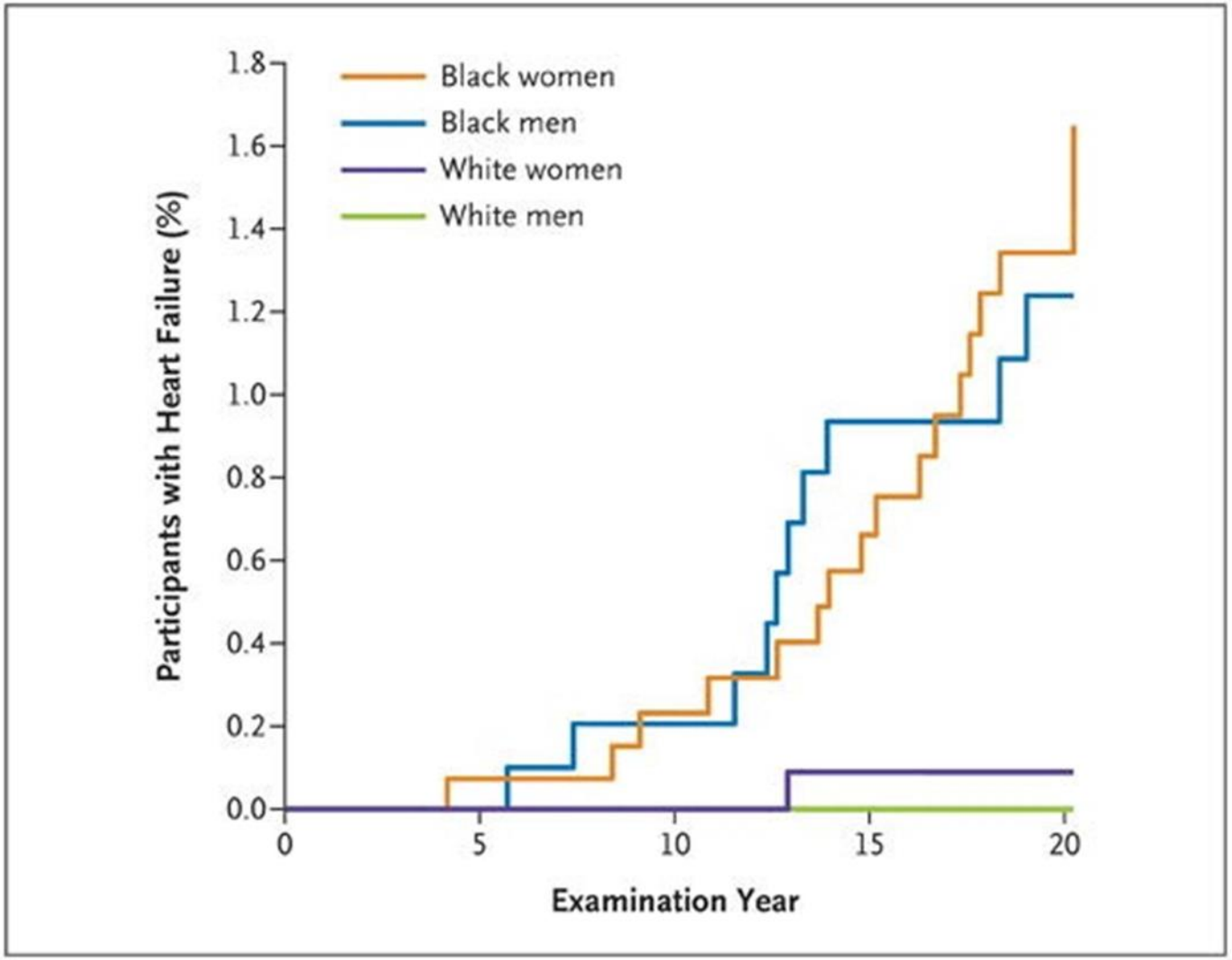
American Heart Association.

Mozaffarian D et al. Circulation. 2015;131:e29-e322

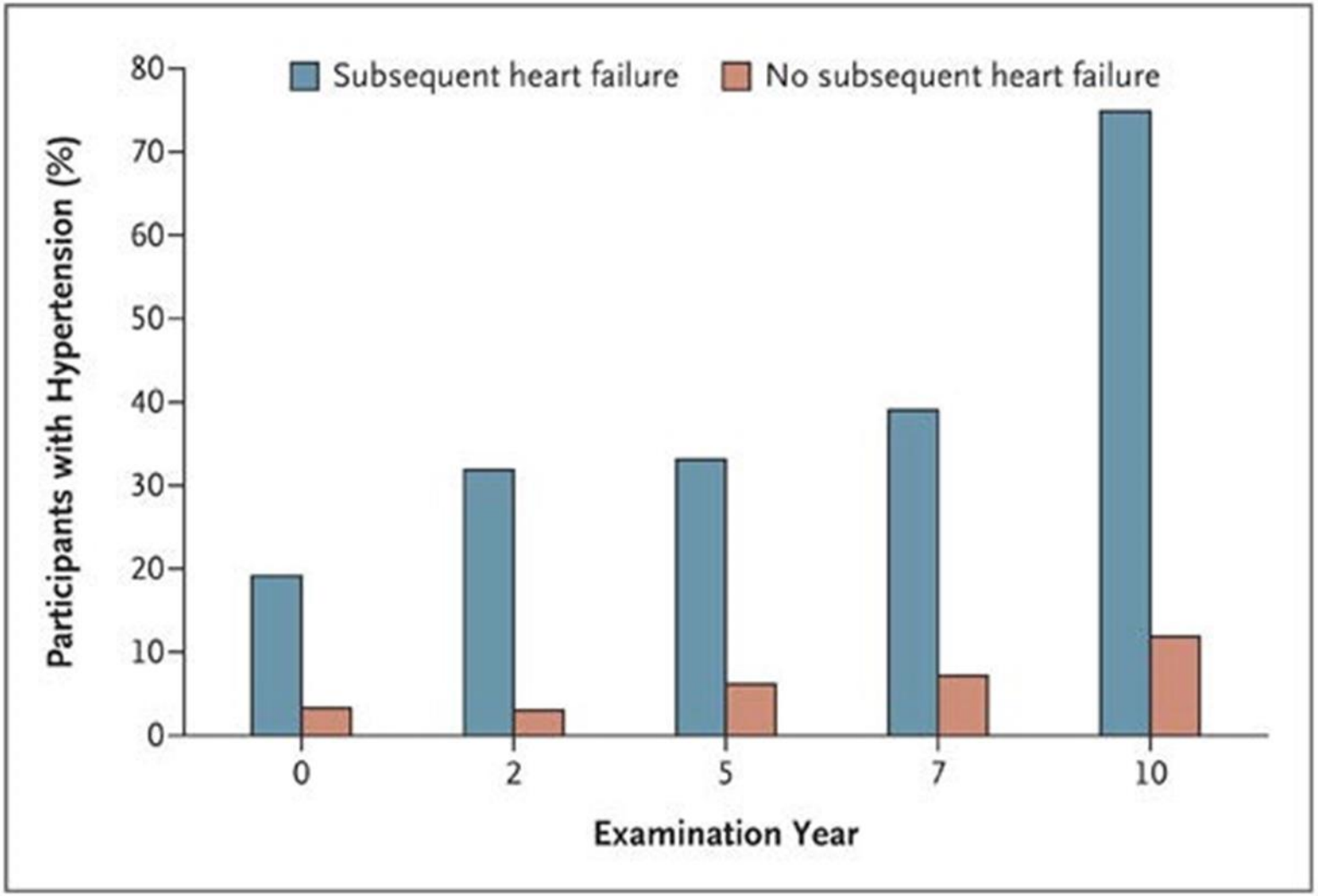
% Decrease in CHD death from 'Prevention' or 'Rescue'



Ford ES et al. N Engl J Med 2007;356:2388-2398.



Bibbins-Domingo K et al. N Engl J Med 2009;360:1179-1190.



Bibbins-Domingo K et al. N Engl J Med 2009;360:1179-1190

Subclinical phenotypes

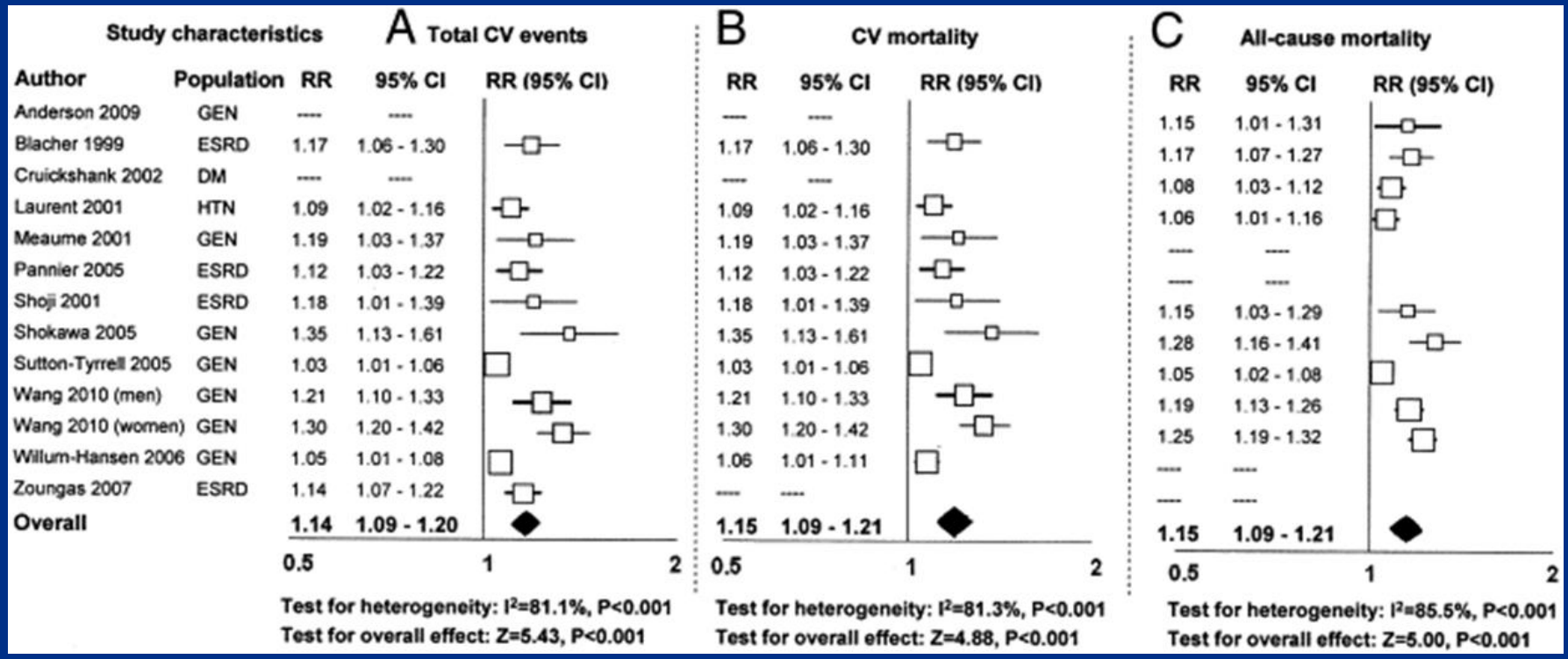
- Vascular
  - Stiffness
  - Thickening
  - Plaque deposition
  - Loss of reactivity
- Cardiac
  - Hypertrophy (Remodelling)
  - Decreased function
  - Metabolic changes
- Brain
  - Vascular
  - Metabolic
  - Structural
- Kidney
  - Proteinuria
  - Structural
  - Vascular
- Others

Implications of left ventricular mass

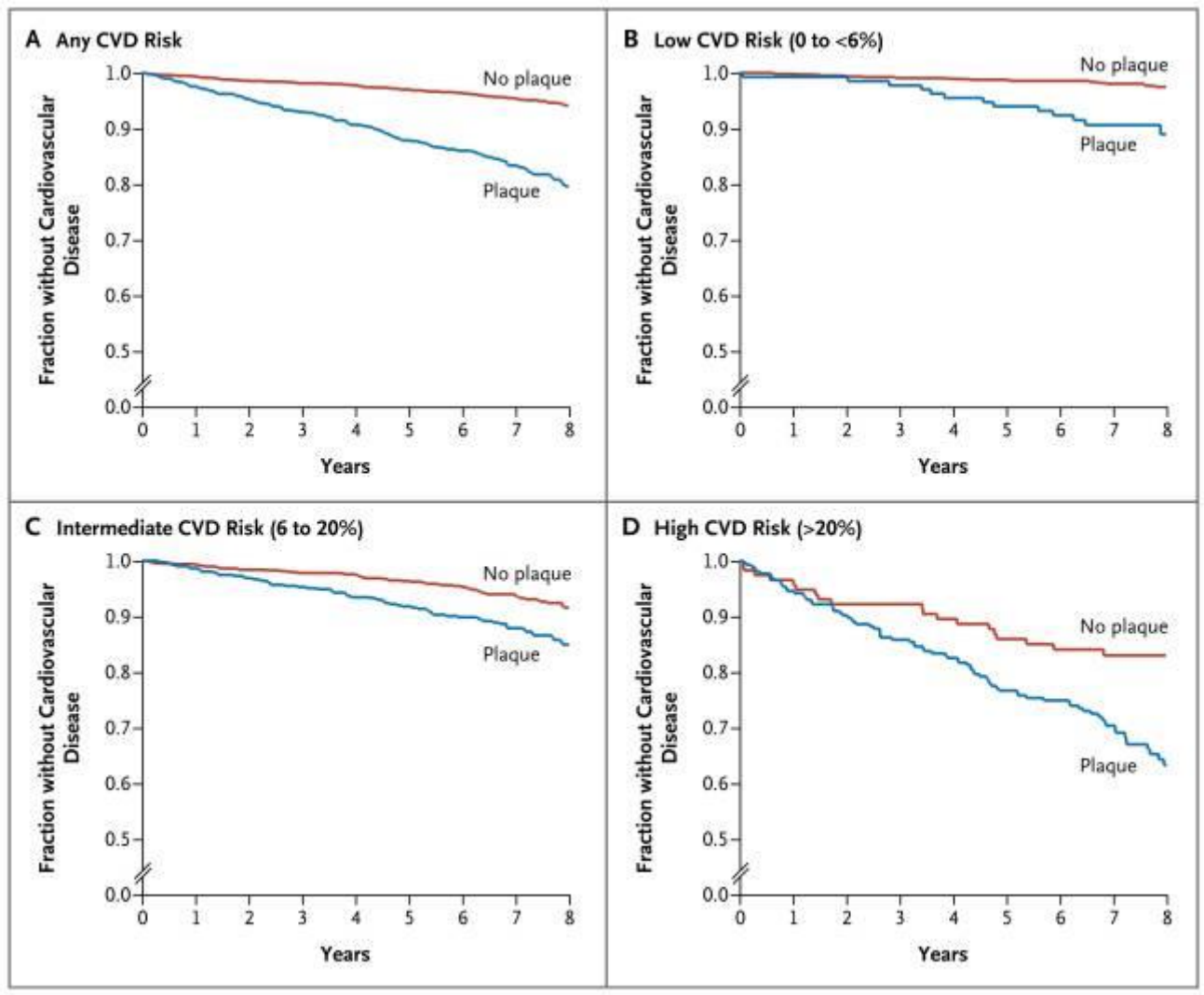
- Adjusted for age, diastolic BP, Pulse Pressure, HTN treatment, smoking, Diabetes mellitus, obesity, Total:HDL-C ratio, EKG LV hypertrophy
- RR [95%CI] per each additional 50g

- Men
  - CVD 1.49 [1.20-1.85]
  - CVD Death 1.73 [1.19-2.52]
  - All Death 1.49[1.14-1.94]
- Women
  - CVD 1.57 [1.20-2.04]
  - CVD death 2.12 [1.28-3.49]
  - All Death 2.01 [1.44-2.81]

Levy et al. NEJM 1990:322:1561-6



Vlachopoulos et al. Journal of the American College of Cardiology. 2010; 55:1318 - 1327

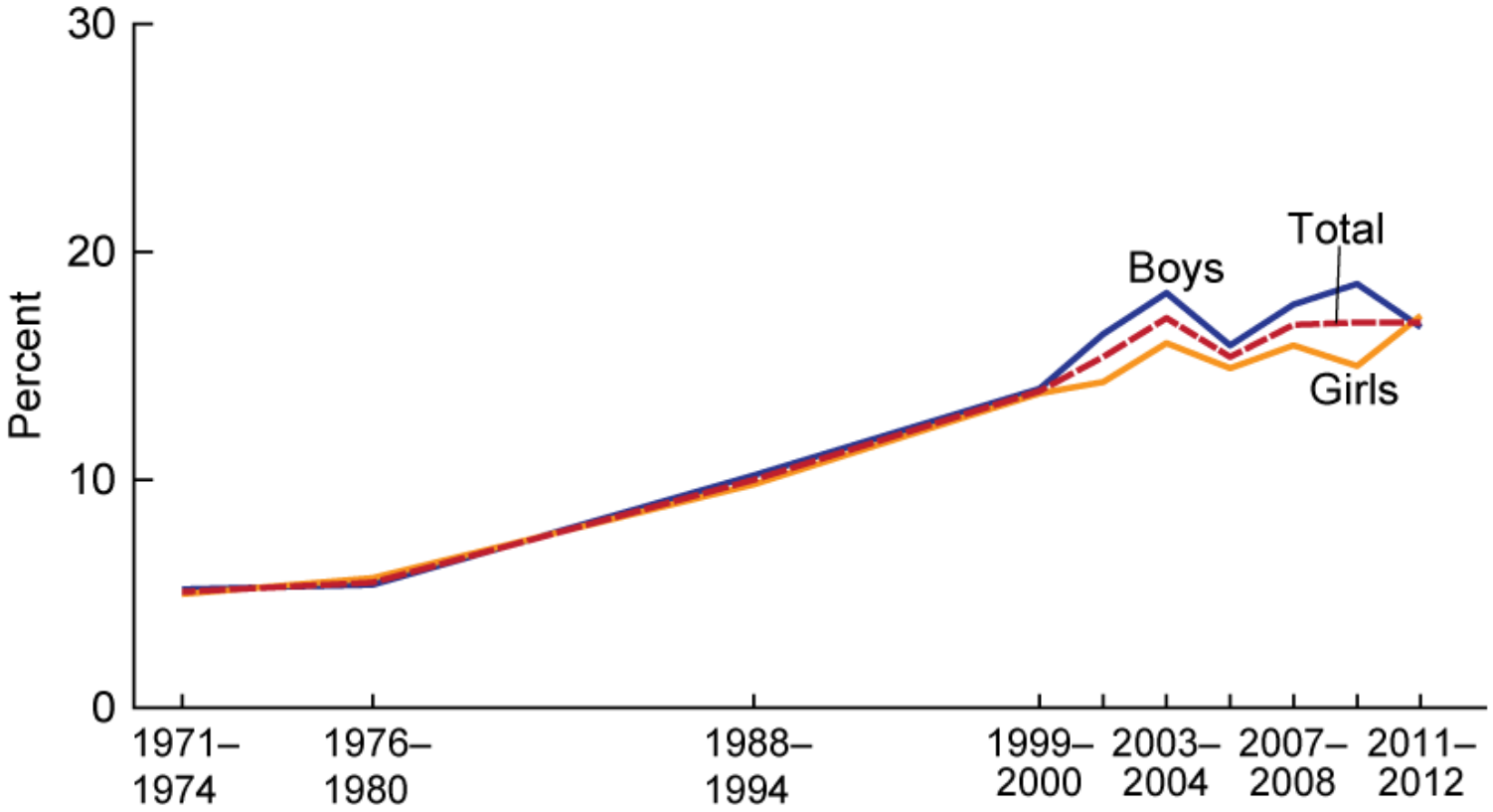


Polak et al. N Engl J Med. 2011 Jul 21; 365(3): 213–221

Kids are the future (of CVD prevention)

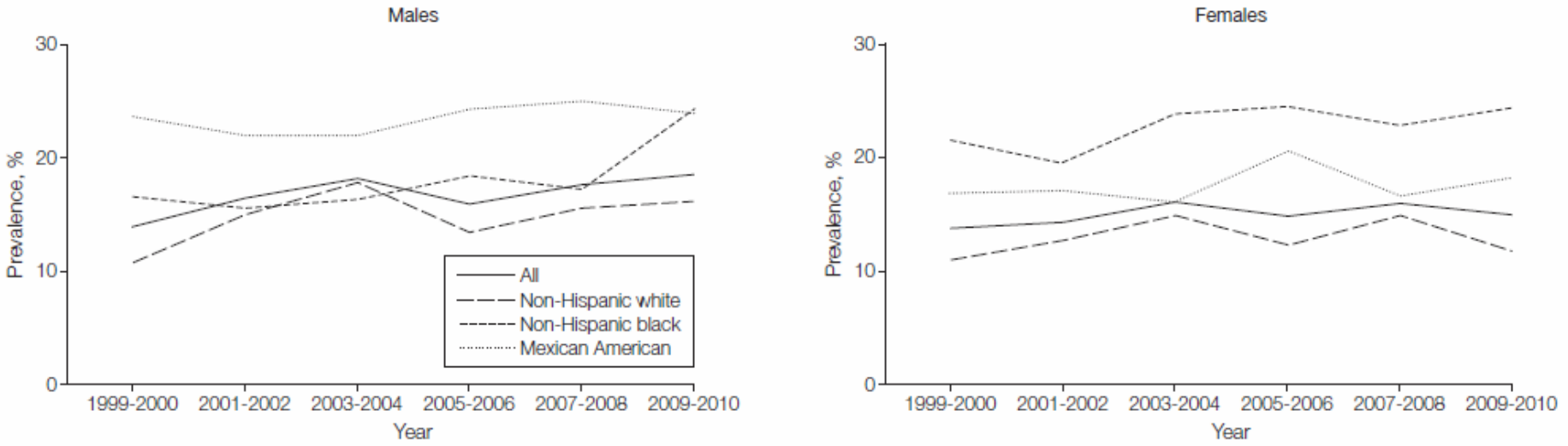
- Physiologic plasticity
- Developmental advantages
- Fewer political obstacles

Figure. Trends in obesity among children and adolescents aged 2–19 years, by sex: United States, selected years 1971–1974 through 2011–2012



NOTE: Obesity is body mass index greater than or equal to the sex- and age-specific 95th percentile from the 2000 CDC Growth Charts.
SOURCE: CDC/NCHS, National Health and Nutrition Examination Surveys 1971–1974; 1976–1980; 1988–1994; 1999–2000, 2001–2002, 2003–2004, 2005–2006, 2007–2008, 2009–2010, and 2011–2012

Figure 2. Prevalence of Obesity in US Males and Females Aged 2 Through 19 Years



Data are weighted.

	% (95% CI)			
	2-19 y	2-5 y	6-11 y	12-19 y
Overweight or Obese (BMI for Age ≥85th Percentile of the CDC Growth Charts)				
All race/Hispanic origin groups[b]				
All	31.8 (29.1-34.7)	22.8 (18.7-27.6)	34.2 (30.1-38.5)	34.5 (30.1-39.2)
Boys	32.0 (29.2-35.0)	23.9 (20.1-28.2)	33.2 (27.7-39.1)	35.1 (29.7-40.9)
Girls	31.6 (27.2-36.5)	21.7 (14.6-31.0)	35.2 (29.2-41.8)	33.8 (27.9-40.4)
Non-Hispanic white				
All	28.5 (24.0-33.4)	20.9 (14.4-29.2)	29.4 (21.6-38.7)	31.2 (24.3-39.1)
Boys	27.8 (22.5-33.8)	21.8 (14.9-30.8)	26.5 (18.2-36.8)	31.5 (21.9-42.9)
Girls	29.2 (22.7-36.7)	19.9 (10.0-35.7)	32.7 (19.8-48.8)	31.0 (22.7-40.7)
Non-Hispanic black				
All	35.2 (30.2-40.6)	21.9 (16.7-28.2)	38.1 (30.1-46.8)	39.8 (32.9-47.2)
Boys	34.4 (30.3-38.7)	22.2 (16.9-28.6)	39.3 (30.5-48.9)	37.3 (30.3-44.9)
Girls	36.1 (28.7-44.4)	21.6 (14.6-30.8)	36.9 (26.9-48.1)	42.5 (31.9-53.8)
Non-Hispanic Asian				
All	19.5 (15.7-23.9)	9.0 (4.5-17.3)[c,d]	19.9 (16.2-24.3)	24.6 (17.8-32.9)
Boys	25.1 (18.7-32.8)	8.3 (2.5-24.0)[c,d]	24.5 (16.6-34.5)	33.9 (23.2-46.6)
Girls	13.7 (8.6-21.2)	9.7 (3.3-25.0)[c,d]	14.9 (8.9-23.9)	15.0 (7.3-28.3)[d]
Hispanic				
All	38.9 (36.3-41.6)	29.8 (24.0-36.4)	46.2 (41.5-50.9)	38.1 (31.9-44.8)
Boys	40.7 (37.3-44.1)	31.4 (23.5-40.5)	48.7 (41.1-56.3)	39.6 (31.3-48.5)
Girls	37.0 (33.4-40.8)	28.1 (19.7-38.3)	43.6 (37.5-49.8)	36.5 (28.8-45.0)

Ogden et al. JAMA. 2014;311:806-14.

Characteristic	% (95%CI)							*P* Value for Linear Trend
	1999-2000	2001-2002	2003-2004	2005-2006	2007-2008	2009-2010	2011-2012	
High TC, ≥200 mg/dL								
Total	10.6 (8.3-13.2)	9.7 (7.1-12.8)	9.8 (7.8-12.2)	9.3 (8.0-10.8)	7.4 (5.6-9.6)	7.0 (5.2-9.2)	7.8 (5.7-10.4)	.006
Boys	9.1 (6.0-13.0)	9.5 (5.3-15.5)	9.1 (6.4-12.4)	10.1 (7.2-13.5)	8.2 (5.4-11.9)	7.8 (5.4-10.9)	6.6 (4.5-9.1)	.14
Girls	12.1 (9.4-15.3)	9.8 (8.1-11.7)	10.7 (7.6-14.5)	8.5 (6.1-11.4)	6.6 (4.5-9.2)	6.1 (4.0-8.8)	9.0 (5.4-13.8)	.007
Low HDL-C, <40 mg/dL								
Total	17.9 (15.0-21.0)	18.7 (16.7-20.8)	11.4 (8.6-14.8)	10.6 (8.6-12.9)	15.6 (13.7-17.7)	13.8 (11.7-16.1)	12.8 (9.8-16.2)	.003
Boys	19.2 (15.7-23.1)	23.0 (19.8-26.4)	15.7 (11.3-20.9)	12.1 (9.0-15.8)	18.3 (15.8-21.1)	16.7 (14.1-19.5)	12.6 (10.3-15.2)	<.001
Girls	16.4 (11.9-21.8)	14.1 (11.8-16.7)	7.0 (4.9-9.6)	9.0 (7.0-11.4)	12.8 (9.8-16.2)	10.8 (7.2-15.5)	12.9 (8.3-18.9)	.30
High non-HDL-C, ≥145 mg/dL								
Total	13.6 (11.3-16.2)	14.6 (12.3-17.1)	10.6 (8.2-13.3)	10.6 (9.2-12.2)	10.0 (7.5-12.9)	8.5 (6.2-11.4)	8.4 (5.9-11.5)	<.001
Boys	13.1 (10.3-16.3)	15.6 (12.2-19.5)	10.4 (6.8-15.1)	10.3 (7.8-13.2)	11.5 (7.9-15.9)	9.0 (6.6-11.9)	7.5 (5.6-9.9)	<.001
Girls	14.2 (11.3-17.5)	13.5 (10.9-16.6)	10.8 (7.7-14.5)	10.9 (8.2-14.2)	8.3 (5.8-11.5)	8.0 (4.9-12.2)	9.2 (5.6-14.1)	.001

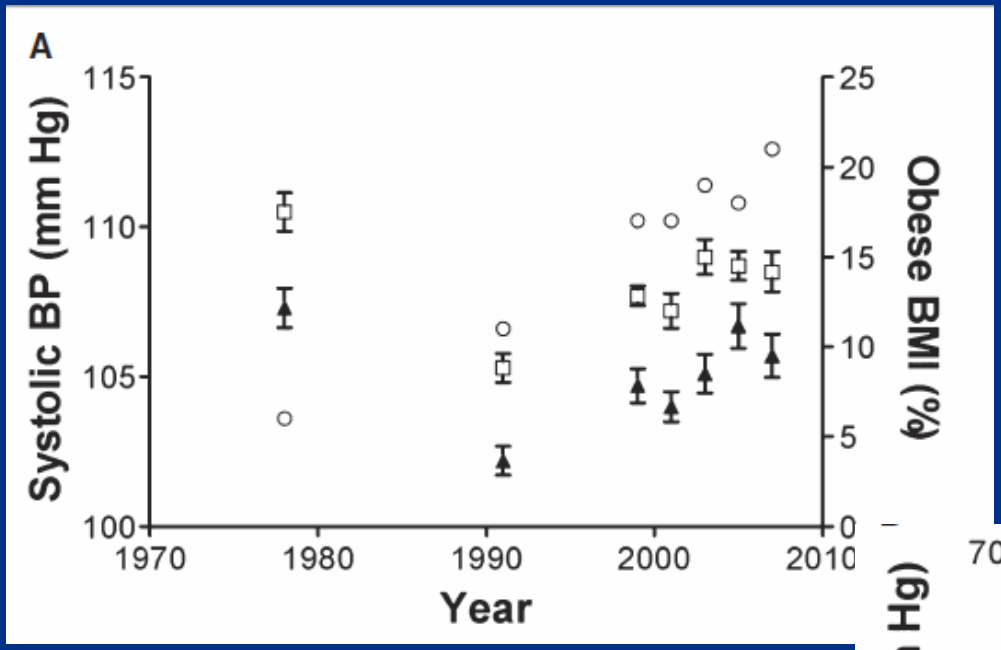
Kit et al. JAMA Pediatrics 2015.epub before print.

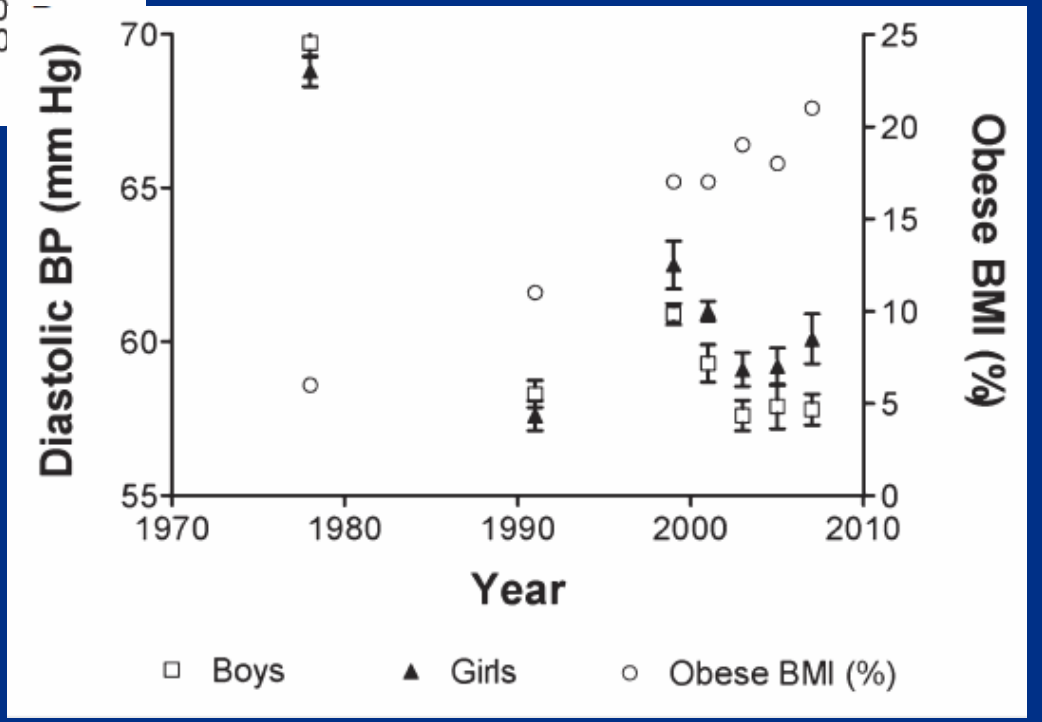
Characteristic	Participants, No.	% (95% CI)			
		TC ≥200 mg/dL	HDL-C <40 mg/dL[b]	Non-HDL-C ≥145 mg/dL[c]	High TC, Low HDL-C, or High Non-HDL-C[d]
Total	1482	7.8 (5.7-10.4)	12.8 (9.8-16.2)	8.4 (5.9-11.5)	20.2 (16.3-24.6)
Sex					
Boys[e]	757	6.6 (4.5-9.1)	12.6 (10.3-15.2)	7.5 (5.6-9.9)	19.3 (16.2-22.8)
Girls	725	9.0 (5.4-13.8)	12.9 (8.3-18.9)	9.2 (5.6-14.1)	21.0 (14.8-28.5)
Age, y					
8-12[e]	785	7.0 (4.4-10.4)	10.5 (6.9-15.1)	6.9 (4.2-10.7)	18.1 (12.5-24.9)
13-17	697	8.5 (5.2-12.9)	14.7 (11.7-18.1)	9.6 (6.1-14.2)	22.0 (18.0-26.6)
Race/Hispanic origin[f]					
Non-Hispanic white[e]	346	7.0 (3.7-11.9)	13.9 (9.5-19.3)	7.7 (3.8-13.5)	19.7 (13.7-27.1)
Non-Hispanic black	433	10.0 (8.3-11.8)	5.6 (3.5-8.5)	9.1 (7.5-10.9)	17.6 (15.1-20.4)
Non-Hispanic Asian	176	7.5 (3.7-13.1)	9.2 (6.0-13.3)	7.0 (2.6-14.6)[g]	16.6 (11.2-23.3)
Hispanic	452	8.6 (6.0-11.8)	15.7 (10.9-21.7)	10.4 (7.8-13.5)	24.2 (19.0-29.9)

Kit et al. JAMA Pediatrics 2015.epub before print.

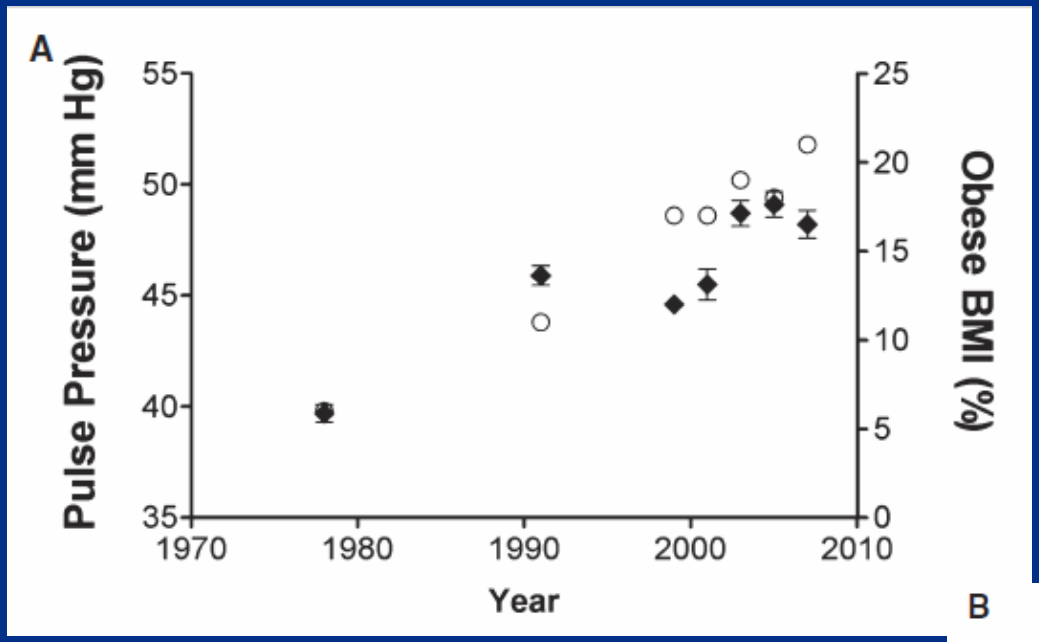
High BP								
Total	3.0 (2.0-4.3)	2.7 (1.7-4.1)	3.1 (1.9-4.8)	2.8 (1.5-4.8)	2.6 (1.8-3.5)	1.7 (1.2-2.5)	1.6 (1.0-2.4)	.003
Boys	3.3 (2.0-5.1)	3.2 (2.1-4.6)	3.1 (1.6-5.4)	2.0 (1.0-3.5)	3.2 (2.0-4.8)	1.6 (0.9-2.7)	1.8 (0.6-4.1)[b]	.03
Girls	2.7 (1.0-6.0)[c]	2.3 (1.2-4.0)	3.1 (1.5-5.7)	3.6 (1.8-6.6)	2.0 (0.7-4.2)[c]	1.9 (1.3-2.7)	1.4 (0.8-2.1)	.11
Borderline high BP								
Total	7.6 (5.8-9.8)	10.0 (8.3-11.9)	9.1 (7.4-11.1)	10.3 (7.7-13.4)	10.1 (8.3-12.2)	7.2 (5.4-9.3)	9.4 (7.2-11.9)	.90
Boys	10.0 (7.8-12.7)	14.1 (11.2-17.5)	13.2 (10.2-16.8)	13.9 (10.0-18.7)	12.5 (8.8-17.0)	10.5 (7.5-14.1)	13.7 (9.5-18.8)	.74
Girls	5.1 (2.9-8.3)	5.7 (4.1-7.7)	4.9 (3.6-6.5)	6.5 (4.2-9.5)	7.7 (5.7-10.0)	3.7 (2.2-5.9)	5.4 (3.0-9.0)	.95
High or borderline high BP								
Total	10.6 (8.4-13.1)	12.7 (10.6-15.1)	12.2 (9.8-15.0)	13.1 (9.4-17.5)	12.7 (10.6-15.0)	8.9 (7.2-10.9)	11.0 (8.8-13.4)	.26
Boys	13.3 (10.7-16.3)	17.3 (14.4-20.5)	16.3 (12.5-20.6)	15.9 (11.3-21.5)	15.6 (11.8-20.0)	12.1 (9.2-15.5)	15.4 (11.0-20.9)	.61
Girls	7.9 (4.3-12.9)	8.0 (5.8-10.7)	8.0 (5.4-11.4)	10.2 (6.7-14.6)	9.7 (7.0-12.8)	5.6 (4.3-7.3)	6.8 (4.0-10.6)	.42

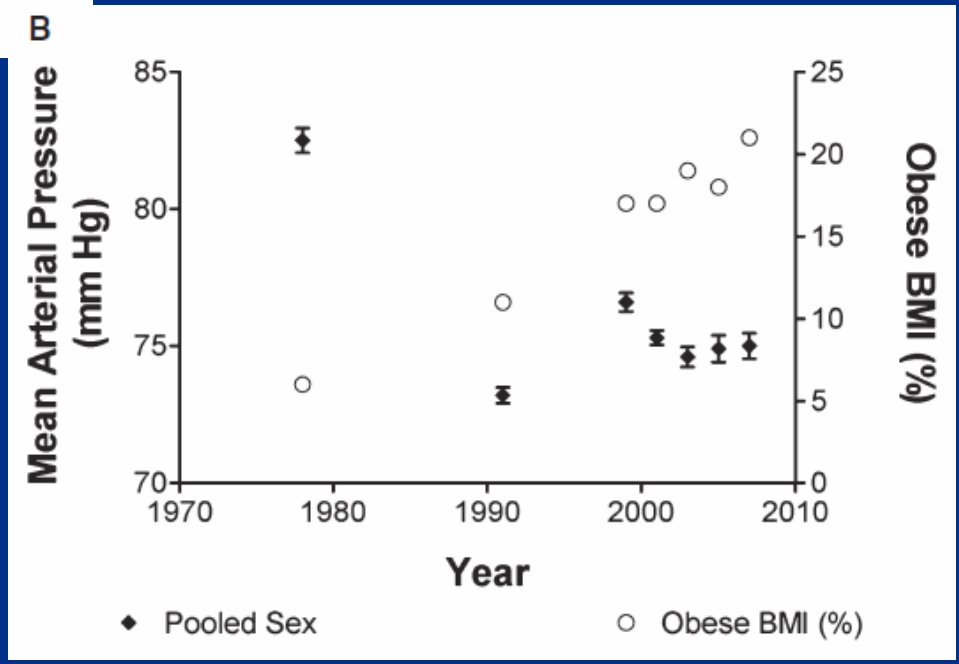
Kit et al. JAMA Pediatrics 2015.epub before print.





Zachariah et al. JAHA. 2014. e000725.


A
Pulse Pressure (mm Hg)
55
50
45
40
35
25
20
15
10
5
0
Obese BMI (%)
1970
1980
1990
2000
2010
Year


B
Mean Arterial Pressure (mm Hg)
85
80
75
70
25
20
15
10
5
0
Obese BMI (%)
1970
1980
1990
2000
2010
Year
Pooled Sex
Obese BMI (%)

Characteristic	Participants, No.[b]	% (95% CI)		
		High BP	Borderline High BP[c]	Either High or Borderline High BP[d]
Total	1665	1.6 (1.0-2.4)	9.4 (7.2-11.9)	11.0 (8.8-13.4)
Sex				
Boys[e]	842	1.8 (0.6-4.1)[f]	13.7 (9.5-18.8)	15.4 (11.0-20.9)
Girls	823	1.4 (0.8-2.1)	5.4 (3.0-9.0)	6.8 (4.0-10.6)
Age, y				
8-12[e]	904	1.9 (1.1-3.0)	4.7 (2.7-7.4)	6.5 (4.5-9.1)
13-17	761	1.3 (0.5-2.8)[g]	13.7 (10.3-17.7)	15.0 (11.2-19.4)
Race/Hispanic origin[h]				
Non-Hispanic white[e]	388	1.1 (0.5-1.9)	8.3 (5.5-12.0)	9.4 (6.7-12.7)
Non-Hispanic black	483	1.9 (0.6-4.3)[f]	13.5 (10.5-17.0)	15.3 (12.5-18.6)
Hispanic	502	2.4 (0.7-5.6)[f]	9.1 (4.3-16.4)	11.5 (6.3-18.7)
Non-Hispanic Asian	203	1.7 (0.5-4.2)[f]	6.9 (3.3-12.4)	8.5 (3.8-16.0)[g]

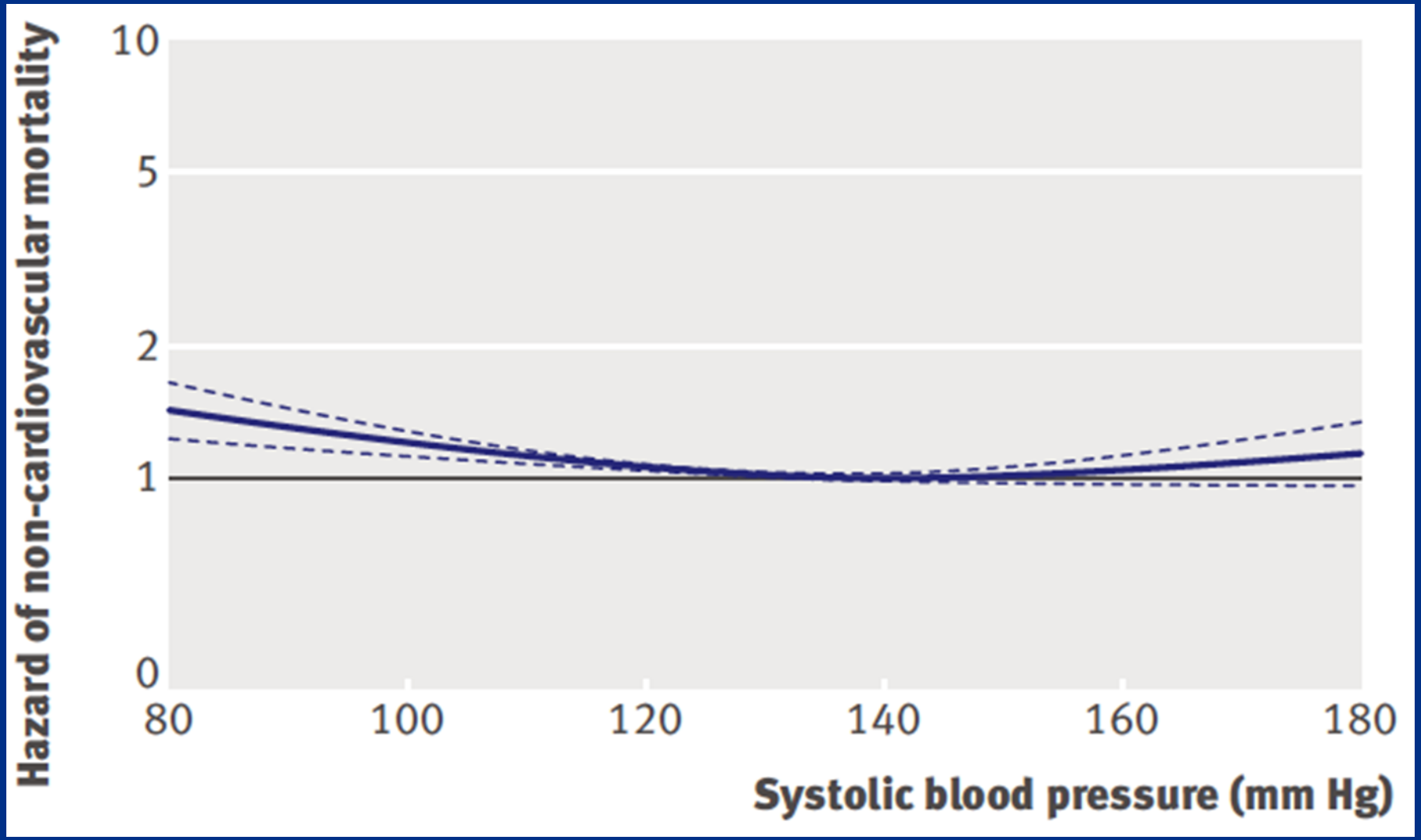
Kit et al. JAMA Pediatrics 2015.epub before print.

Table 3. Suggested Revised Schema for Staging of Ambulatory BP Levels in Children

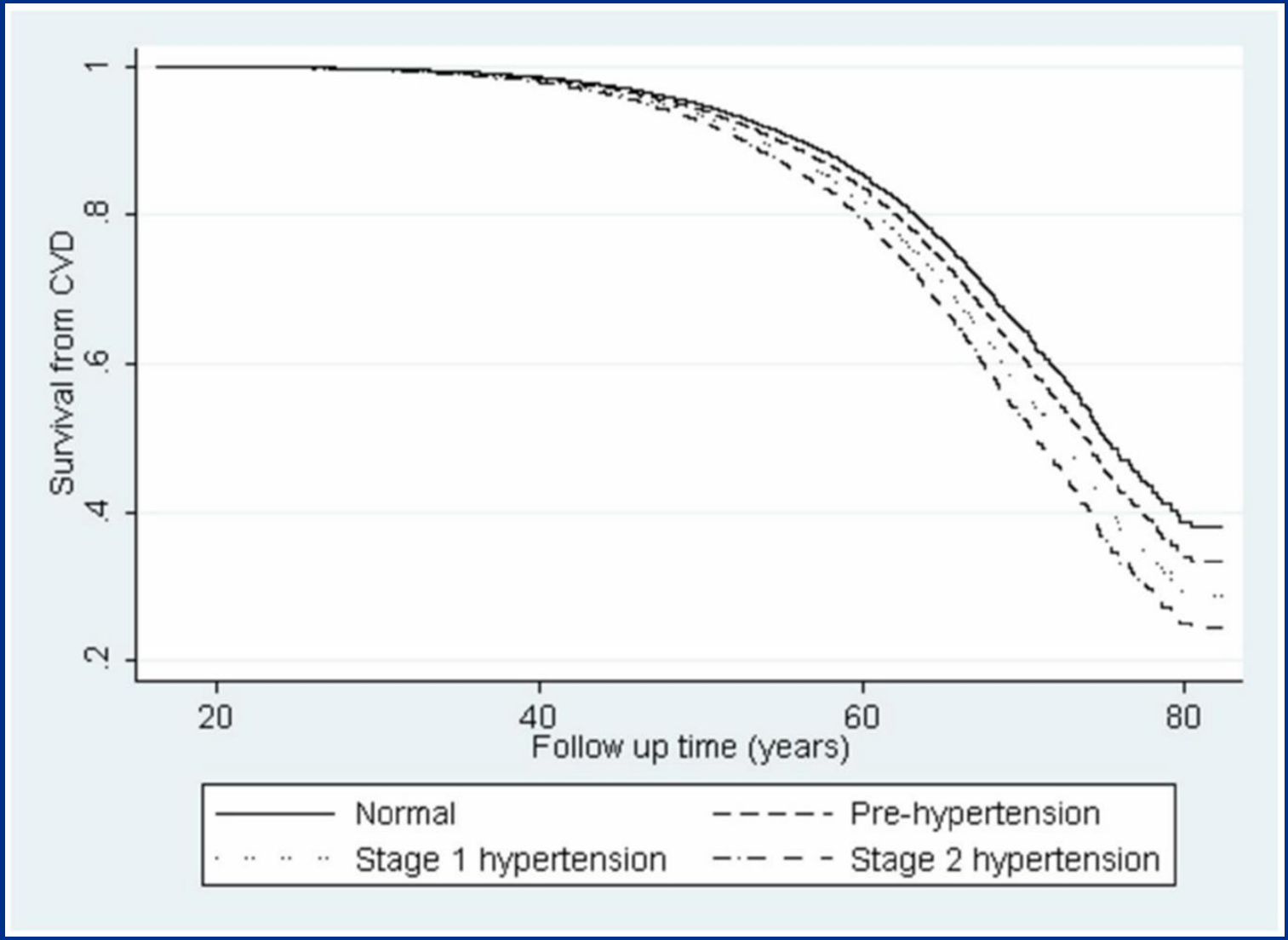
Classification	Office BP*	Mean Ambulatory SBP or DBP†‡	SBP or DBP Load, %‡§
Normal BP	<90th %tile	<95th %tile	<25
White coat hypertension	≥95th %tile	<95th %tile	<25
Prehypertension	≥90th %tile or >120/80 mm Hg	<95th %tile	≥25
Masked hypertension	<95th %tile	>95th %tile	≥25
Ambulatory hypertension‖	>95th %tile	>95th %tile	25–50
Severe ambulatory hypertension (at risk for end-organ damage)	>95th %tile	>95th %tile	>50

marker for renal deterioration. Racial differences also have been demonstrated in nocturnal dipping, with a difference in the relationship between body size and BP contributing to the elevated nighttime pressures seen in African American as compared with white youth.[92]

Flynn et al. Hypertension 2014. 63:1116-35. Urbina et al. Hypertension 2008. 52:433-51.



Sundstrom et al. British Medical Journal 2011.

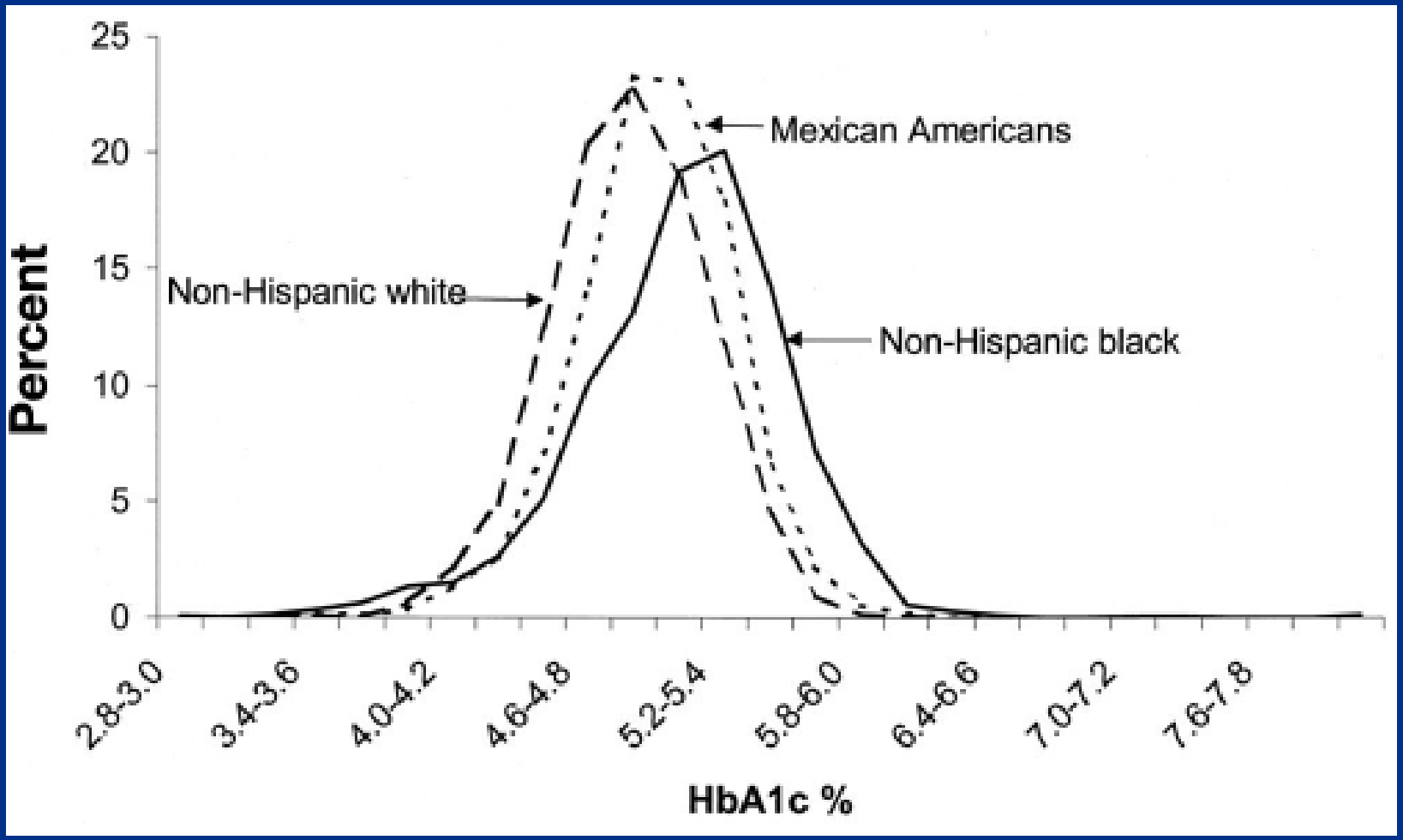


Gray et al. Journal of the American College of Cardiology 2011.

	All T2DM[a]			Diagnosed T2DM[a]			Undiagnosed T2DM[a]		
	No. of Persons[b]	%[c]	95% CI[c]	No. of Persons[b]	%[c]	95% CI[c]	No. of Persons[b]	%[c]	95% CI[c]
Total population	119,224	0.36	0.20, 0.67	78,613	0.24	0.11, 0.51	40,611	0.12	0.05, 0.31
Sex									
Male	74,523	0.44	0.19, 1.02	44,087	0.26	0.08, 0.82	30,436	0.18	0.06, 0.55
Female	44,701	0.28	0.13, 0.60	34,526	0.22	0.09, 0.53	10,175	0.06	0.01, 0.29
Race/ethnicity									
Non-Hispanic white	56,171	0.28	0.10, 0.80	44,783	0.22	0.07, 0.72	11,388	0.06	0.01, 0.40
Non-Hispanic black	18,904	0.40	0.14, 1.14	12,819	0.27	0.07, 1.07	6,084	0.13	0.03, 0.50
Mexican-American	27,386	0.73	0.40, 1.40	17,737	0.48	0.22, 1.04	9,649	0.26	0.09, 0.75
Other Hispanic	0			0			0		
Other[d]	16,764	0.77	0.17, 3.40	3,274	0.15	0.01, 2.04	13,490	0.62	0.11, 3.45

Demmer et al. Am J Epi 2013.178:1106-13.

HgbA1c in NHANES ages 5–24



Herman. J Diabetes Sci Technol. 2009; 3: 656–660.

Left ventricular Hypertrophy: Child to Young Adult

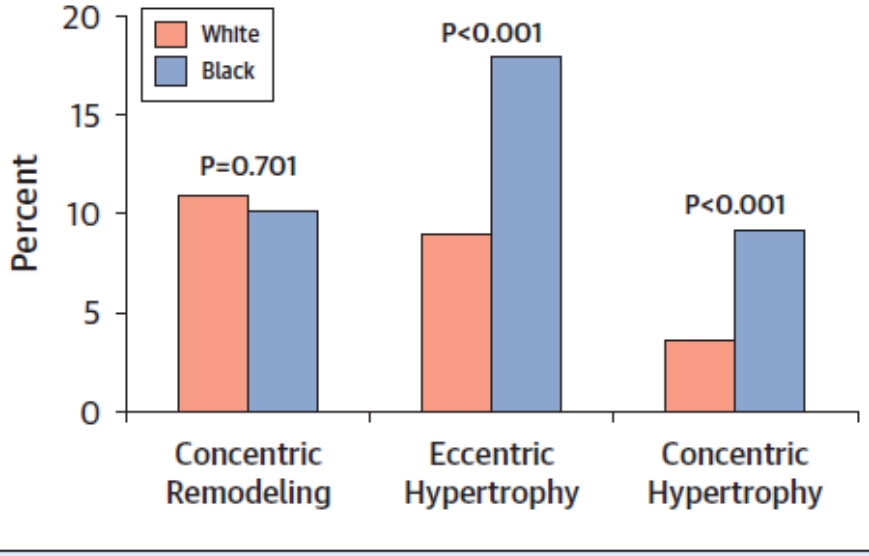


FIGURE 2 **Prevalence of LV Remodeling Patterns, by Race**

Concentric remodeling, eccentric hypertrophy, and concentric hypertrophy were defined by cutoffs of left ventricular (LV) mass index (46.7 g/m$^{2.7}$ in women and 49.2 g/m$^{2.7}$ in men) and relative wall thickness (0.42).

Lai et al.
JACC Imaging 2014;
64:1580-7.

TABLE 2 Effects of LVMI and LVH on BMI and SBP (Linear and Logistic Regression Analyses)

Independent Variable	Dependent Variable	
	LVMI*	LVH†
Childhood (Model I‡)		
BMI	0.26§ (0.20-0.32)	1.65§ (1.39-1.97)
SBP	0.08‖ (0.01-0.14)	1.27‖ (1.04-1.54)
Adulthood age	0.16§	1.09§
Sex	-0.10§	1.14
Race	0.16§	2.58§
Adulthood (Model II¶)		
BMI	0.42§ (0.37-0.48)	2.53§ (2.06-3.09)
SBP	0.16§ (0.10-0.21)	1.56§ (1.28-1.90)
Adulthood age	0.14§	1.10§
Sex	-0.11§	1.12
Race	0.17§	2.97§
Total AUC (Model III#)		
BMI	0.41§ (0.36-0.47)	2.42§ (1.98-2.95)
SBP	0.14§ (0.09-0.20)	1.47§ (1.20-1.80)
Adulthood age	0.15§	1.12§
Sex	-0.10§	1.16
Race	0.17§	2.96§
Incremental AUC (Model IV**)		
BMI	0.33§ (0.28-0.39)	2.09§ (1.72-2.53)
SBP	0.10§ (0.05-0.16)	1.43§ (1.19-1.72)
Adulthood age	0.17§	1.13§
Sex	-0.10§	1.13
Race	0.17§	2.80§

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Take Home

- CVD events are declining
- Risk factor management is a key driver
- Abnormal CVD Risk Factor prevalence in youth is high, but may be stable or declining
- Racial Disparities are present in
  - Abnormal CVD risk factor prevalence
  - Subclinical atherosclerotic precursors
- Disparities may lead to CVD event differences

Thank you for your attention.

Questions?